Tutoriel Work of Chapter 1: Semiconductor- Diode

Exercise N°1

1- Calculate the following Laplace transforms :

a) $\mathcal{L}\left[\left(t^2+t-e^{-3t}\right)\mathcal{U}(t)\right]$ b) $\mathcal{L}[\sin(2t)\cos(2t)]$ c) $\mathcal{L}\left[(\cos(2t)-\sin(t))\,e^{-3t}\,\mathcal{U}(t)\right]$

2- Calculate the originals time-domain signals of the following Laplace transforms:

a) $\mathcal{L}^{-1}\left[\frac{s+2}{(s+3)(s+4)}\right]$ b) $\mathcal{L}^{-1}\left[\frac{3}{(s+5)^2}\right]$ c) $\mathcal{L}^{-1}\left[\frac{s-1}{(s^2+2s+5)}\right]$

3- Use the Laplace transform to determine the solution of each of the following differential equations:

a) $x'(t)+x(t)=t\,\mathcal{U}(t)-t\,\mathcal{U}(t-1)$ *Initial Condition* : $x(0)=0$

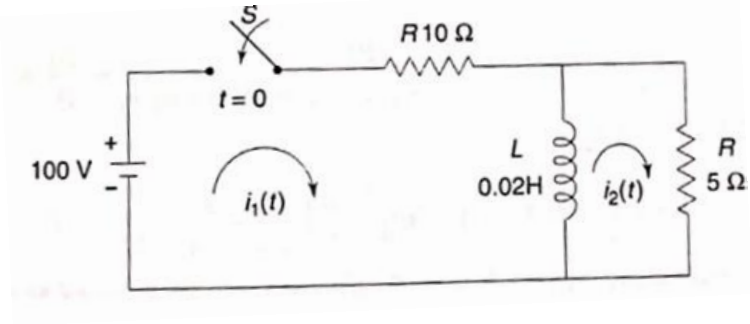
b) $x''(t)+6x'(t)+9x(t)=e^{-2t}\,\mathcal{U}(t)$ *with* : $x(0)=0$ et $x'(0)=0$

c) $x''(t)+4x(t)=2\,\mathcal{U}(t)$ *Initial Conditions* : $\begin{cases} x(0) = 0 \\ x'(0) = 1 \end{cases}$

4- In the following circuit

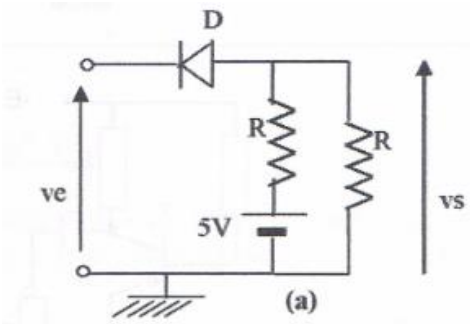
a- Find the current $i_1(t)$, $i_2(t)$ and the output voltage across 5Ω resistor when the switch is closed

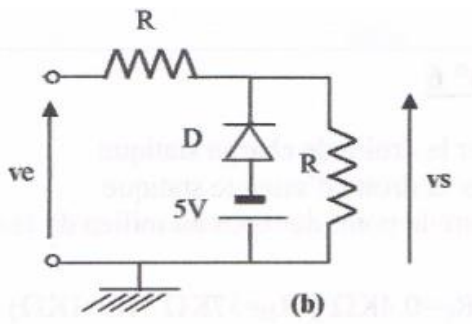
b- Determine the initiial and final values of current.



Exercise N°2

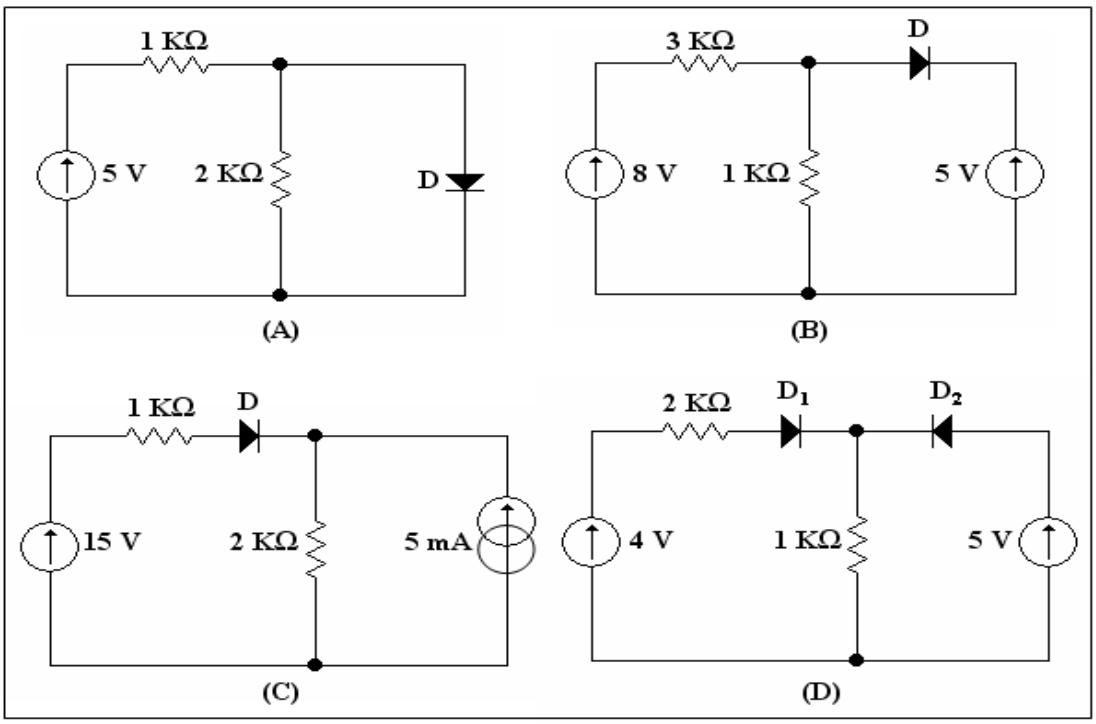
The input voltage ve(t) is a sinusoidal of amplitude 10 V and period 20ms. Draw the graph of the output voltage vs(t) for each circuit





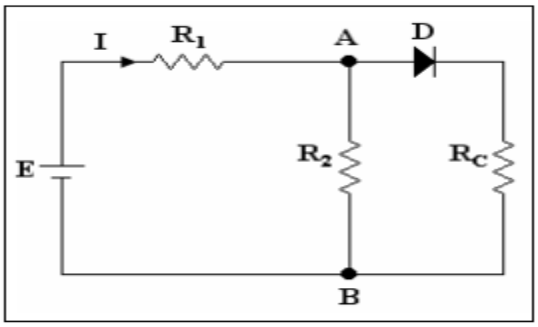
Exercise N° 3

For each of the following circuits, determine the state of the diode, assumed to be ideal, and calculate the value of the current flowing through it.



Exercise N°4

Consider the following circuit

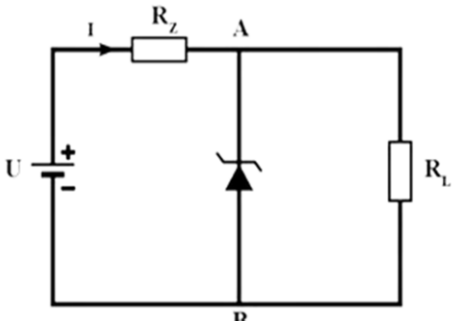


1- Replace the circuit seen between A and B with its equivalent Thévenin generator, and calculate E_{Th} and R_{Th}.
2- Calculate the current I in the following three cases:
   a. The diode is ideal.
   b. The diode is thresholded (V_D=0.7 V).
   c. Diode with threshold and resistance R_D.

Given: E=12 V, R_1=6 KΩ, R_2=3 KΩ, R_C=1 KΩ et R_D=100 Ω.

Exercise N°5

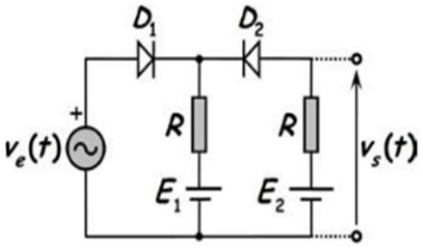
Find the current through the Zener diode given: R_z=1kΩ, U_z=9V, U=15V et R_L =2KΩ



Exercise N°6

Consider the ideal diode circuit shown opposite with:

$$v_e(t) = 100sin(\omega t), E_1 = 25V \text{ and } E_2 = 75V.$$



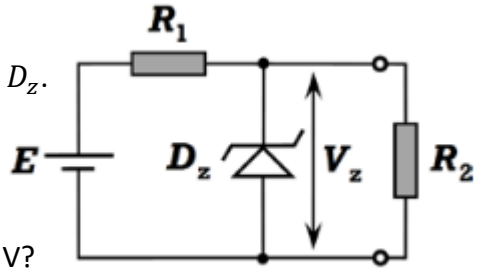
For each combination shown in the table opposite, you are asked to :

1- Give the equivalent circuit diagram. Specify the condition(s) on $v_e(t)$
2- Find the expression for $v_s(t)$.
3- Draw the curves for $v_s(t)$ and $v_s = f(v_e)$

State of $D1$	State of D2	Condition on $v_e(t)$	$v_s(t)$
Bypass	Bypass		
Bypass	Blocking		
Blocking	Bypass		
Bypass	Blocking		

Exercice N°7

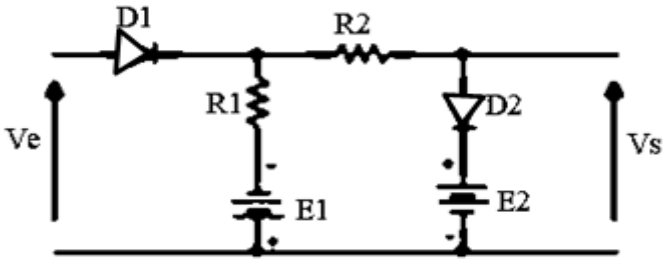
Consider the circuit shown in the adjacent figure with $V_{z_0} = 12V$ and $R_1 = 1k\Omega$, D_z is assumed to be ideal



1- Draw the inverse characteristic of D_z
2- By applying $= 16\ V$, we measure a voltage $V_z = 6\ V$ across D_z. Calculate the value of R_2 .
3- Calculate the currents I_1 , I_2 and I_z flowing, respectively, through R_1 , R_2 and D_z for E = 35 V .
4- For what minimum value of E , does the voltage V_z reach 12 V?
5- Plot the voltage transfer characteristic $Vz = f\ (E\ )$.

Exercise N°8

Consider the circuit shown in the following figure, using 2 superimposed ideal diodes.



Plot the shape of the output voltage vs(t) when the input voltage ve(t) is triangular, periodic with :

- Frequency of 1kHz ;
- Zero mean value
- Amplitude 100V peak-to-peak and such that ve(t=0)=-50V.

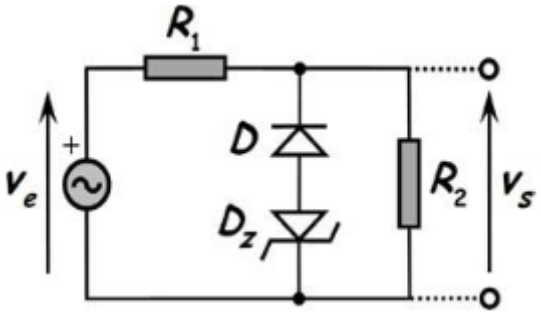
we give : E1=30V, E2=20V, R1=1kΩ and R2=1KΩ

Exercice N°9

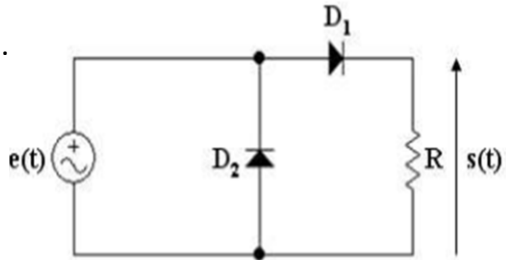
Consider the circuit shown below. Draw the voltage curve across resistor R_2

We give : $\boldsymbol{v_e(t) = V_M \sin \omega t}$ with $\boldsymbol{V_M = 36V}$, $\boldsymbol{R_1 = 150\,\Omega}$,

$\boldsymbol{R_2 = 100\,\Omega}$, $\boldsymbol{D(V_0 = 0.7V, R_d = 0)}$, $\boldsymbol{D_z\left(V_{z_0} = 10V, R_z = R_d = 0, V_0 = 0\right)}$



Exercise N°10



Consider the circuit shown opposite (single-ended rectifier).
Let D1 and D2 be ideal, and $e(t) = 100\sqrt{2}sin(100\pi t)V$

1- Calculate s(t) as a function of e(t).

2- Draw s(t), VD1 and VD2.

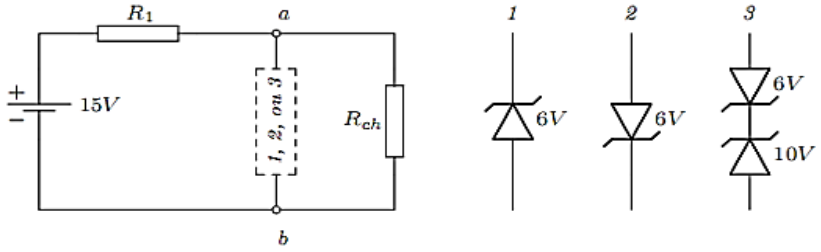
3- Determine the value of R so that the current flowing through it has an RMS value equal to 10 mA.

4- Calculate the maximum and average values of the current flowing through R.

5- Calculate the maximum, rms and mean values of the voltage across the load.

Exercice N°11

Consider the following circuit, in which either element (1), element (2) or both elements (3) are alternately connected between terminals a and b.



Calculate the voltage Vab and the current in the load resistor R_{ch} in the three cases, given that $R_{ch} = 1\ k\Omega\ and\ R_1 = 100\ \Omega$. The voltages across the Zener diodes in reverse conduction are shown in the figure.

Exercise N°12

The data sheet for a Zener diode gives:

$$Vz = 12V, Iz = 50mA, Izmin = 0.5mA, Izmax = 100mA\ and\ Rz = 20\Omega$$

1. Calculate voltages $Vzmin$ and $Vzmax$

2. Determine the equation of the characteristic (the straight line) of the zener diode.

3. Calculate voltages V_{z1} and V_{z2} for respective currents :

$$I_{z1} = 20mA\ and\ I_{z2} = 80mA$$